

Broadband, 802.16 and WiMAX

Khoo Teng Lock
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What is Broadband?

- Recommendation ITU-R F.1399
 - BWA connection capabilities that are higher than the primary rate.
 - Primary Rate: Up to 1.544 Mbps service on a T-1 or up to 2.048 Mbps service on an E1 line
- National Policy driven
 - Connections that can deliver the desired applications to the community at large or to rural communities.
 - VoIP, Internet access (e-government applications/submissions)
- Malaysian broadband definition:
 - Any service beyond the scope of existing PSTN/ISDN and 2G cellular networks
 - With data rates that exceed the the normal voice-related speed (56 kbps for PSTN and 64 kbps for ISDN)
 - Can support the delivery of interactive multimedia (video, image, data, music, telephone and other applications) services to consumers.

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Notes

WiMAX forum

- An industry-led, non-profit corporation with more than 400 members, including leading equipment manufacturers, service providers and systems integrators
- Certifies compatibility and interoperability of broadband wireless products
- Supports the industry-wide acceptance of the IEEE 802.16 and ETSI HiperMAN wireless MAN standards
- WiMAX Forum promotes reasonable royalties through a standards-based solution

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What is WiMAX

- **Wireless Metropolitan Area Networks (MAN)**
- **Offering Broadband Wireless Access**
- **Last/first mile wireless broadband connectivity**
- **Video, Data, Voice and Backhaul**
- **Rural, Urban and Suburban**
- **Non-Line-Of-Sight Fixed, Nomadic, and Mobile wireless broadband connectivity**

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IEEE 802.16 Standards in WiMAX

- **Frequency range:**
 - 2 to 11 GHz, NLOS licensed and unlicensed
 - 10 to 66 GHz, LOS
- **IEEE 802.16-2004 was released in 2003**
 - Fixed WiMAX
- **IEEE 802.16e-2005 was concluded in 2005**
 - Mobile WiMAX
- ▶ **IEEE 802.16 does NOT specify**
 - specific frequency bands
 - the duplexing in a frequency band: both TDD & FDD supported
 - certification requirements

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WiMAX certification

- Development of Test Scripts for Validation
- Lab Preparation- involves validating test scripts, sourcing relevant test tools, opening the lab, preparing test hardware, integrating test scripts into the test hardware and accepting vendor equipment
- Validation testing of Test Scripts and Test Bed
 - Before a test script is released for use in the lab (test bed), it must be tested with a minimum of three (3) vendor products for a given profile.
- Certification Testing
 - Conformance testing to verify a vendor's implementation of the standard is compliant to a set of 802.16-specifications selected by the WiMAX Forum.
 - Interoperability testing to verify:
 - a vendor's subscriber unit is able to establish a link and communicate with two other vendor's base stations, or
 - a vendor's base station is able to establish a link and communicate with two other vendor's subscriber unit

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System & Certification Profiles

- System profile
 - is a complete set of MAC and PHY layer features and their associated parameters, which collectively specify the WiMAX system definition based on the IEEE 802.16 and ETSI HiperMan standards.
 - also defines radio layer, Duplex mode, and a Power Class. The system profile as approved by the WiMAX Forum is defined by the Technical Working Group (TWG).
- Certification Profile
 - is a subset of the system profile specifying
 - the supported channel bandwidth
 - duplex mode (e.g. 3.5GHz, 5MHz, TDD) for each applicable frequency band.
- WiMAX Forum Certification of products are tested and certified to a specific certification profile.
- Selection of certification profiles are based upon market demand.

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WiMAX system profiles

WiMAX system profiles: Fixed, Mobile and Evolutionary WiMAX

	Fixed WiMAX	Mobile WiMAX	Evolutionary WiMAX
Standard	IEEE 802.16-2004	IEEE 802.16e-2005	IEEE 802.16e-2005
Multiplexing	OFDM	OFDMA	OFDM
FFT size	256	512, 1024	256
Duplexing mode	TDD, FDD, HFDD	TDD, FDD, HFDD ₁₀	TDD, FDD, HFDD
Modulation	BPSK, QPSK, 16-QAM, 64-QAM	QPSK, 16-QAM, 64-QAM (uplink)	BPSK, QPSK, 16-QAM, 64-QAM (optional)
Channel bandwidths	3.5, 7, 10 MHz	5, 7, 8.75, 10 MHz	3.5, 5, 7 MHz
Frequency bands	3.4-3.6 GHz 5.7-5.8 GHz	2.3-2.4 GHz 2.305-2.320, 2.345-2.360 GHz 2.496-2.69 GHz 3.3-3.4 GHz 3.4-3.8 GHz	2.305-2.320, 2.345-2.360 GHz 3.4-3.6 GHz 4.9-5.0 GHz

Source: WiMAX Forum

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Currently Approved Certification Profiles

WiMAX System Profiles and Currently Approved Certification Profiles*

SYSTEM PROFILES	CERTIFICATION PROFILES		
	Spectrum	Duplexing	Channel Width
Fixed WiMAX (IEEE 802.16-2004, OFDM)	3.4 - 3.6 GHz	TDD	3.5 MHz
	3.4 - 3.6 GHz	TDD	7 MHz
	3.4 - 3.6 GHz	FDD	3.5 MHz
	3.4 - 3.6 GHz	FDD	7 MHz
	5.725 - 5.850 GHz	TDD	10 MHz
Evolutionary WiMAX (IEEE 802.16e-2005, OFDM)	4.935 - 4.990 GHz	TDD	5 MHz
Mobile WiMAX (IEEE 802.16e-2005, OFDMA)	2.3 - 2.4 GHz	TDD	5, 10 MHz (dual)
	2.3 - 2.4 GHz	TDD	8.75 MHz
	2.496 - 2.690 GHz	TDD	5, 10 MHz (dual)
	3.4 - 3.6 GHz	TDD	5 MHz
	3.4 - 3.6 GHz	TDD	7 MHz
Color Key:		Certified Equipment Available	Eligible Certification Profiles

* Candidate certification profiles are regularly reviewed by the WiMAX Forum Board of Directors. This table will be updated as new certification profiles are approved.

The WiMAX Forum expects to begin certification for mobile products soon with the first WiMAX Forum Certified products expected in Q2 2007.

Source: <http://www.wimaxforum.org/regulators/profiles/#certification>

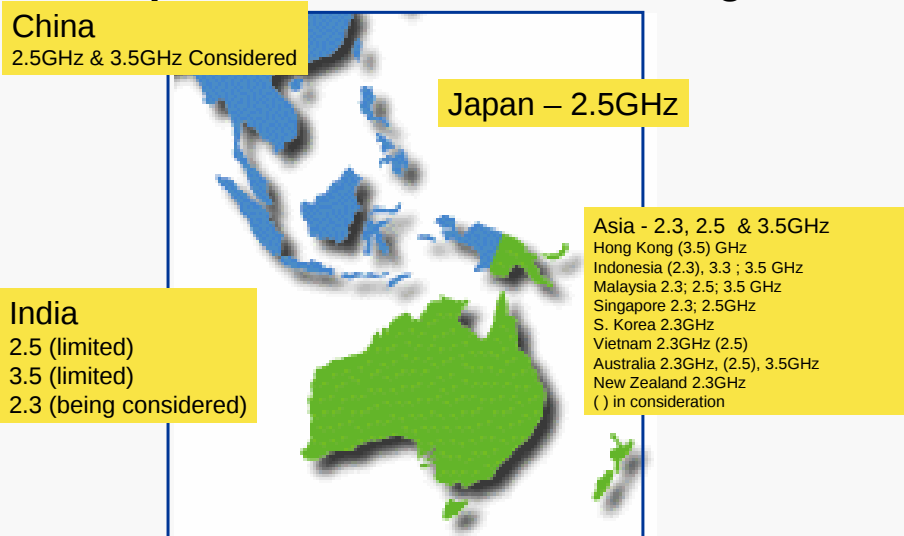
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BWA Spectrum Allocation: Asia Region



Harmonized WiMAX spectrum is beginning to take shape in Asia Pacific

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WiMAX 2.3 GHz band

Certification Profiles

System Profile	Frequency band	Duplexing	Channel width
Mobile WiMAX	2300 – 2400 MHz	TDD	5, 10; 8.75* MHz

*Korea

- This is a key globally harmonized band for mobile WiMAX (802.16e) and is becoming the regional harmonized band in Asia
- Spectrum per operator: 20 to 30 MHz.
- Certified Mobile WiMAX equipment in this band is expected to be available from several vendors this year.

TDD is preferable for broadband data-centric services

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WiMAX 2.5 GHz band

Certification Profiles

System Profile	Frequency band	Duplexing	Channel width
Mobile WiMAX	2496 – 2690 MHz	TDD	5, 10 MHz

- This is the most important globally harmonized band for mobile WiMAX (802.16e).
- Spectrum per operator: 20 to 30 MHz
- Certified Mobile WiMAX equipment in this band is expected to be available from several vendors this year.

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WiMAX 3.5 GHz band

Certification Profiles

System Profile	Frequency band	Duplexing	Channel width
Fixed WiMAX	3400 – 3600 MHz	TDD, FDD	3.5 , 7 MHz
Mobile WiMAX	3400 – 3600 MHz	TDD	5, 7 MHz

- Certified equipment in this band is already available from several vendors.
 - As at Nov 2006: 13 vendors for base station; 13 vendors for CPE
- Spectrum per operator: 20 to 30 MHz

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Mobile WiMAX & IMT-2000

- IEEE submitted a contribution to the ITU-R WP8F meeting held in Cameroon in January 2007
 - that ITU-R Recommendation M.1457-6 be revised to add a new radio interface designated as IP-OFDMA
- IP-OFDMA is consistent with mobile WiMAX Release-1 profiles specifying
 - TDD and 5 & 10 MHz channel widths
- Mobile WiMAX is currently the only global open standard that employs OFDMA technology and has evolved from a data-centric vision
- Since year 2000, no new technologies have applied to M.1457

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Summary

- Broadband is defined to further national objectives
- WiMAX standards are based on IEEE 802.16
- WiMAX forum defines systems & certification profiles and enables the creation & management of a certification programme.
- Harmonized WiMAX spectrum is beginning to take shape in Asia Pacific in the 2.3 GHz, 2.5 GHz and 3.5 GHz bands.
- Desired amount of spectrum per operator is 20 to 30 MHz
- The addition of IP-OFDMA in M.1457 will introduce a global open standard that has evolved from a data-centric vision to complement 3G technologies that have evolved from initial focus on voice.

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Resources on WiMAX information

- General public
 - <http://www.wimaxforum.org>
- Regulators
 - <http://www.wimaxforum.org/regulators>

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Thank You



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